

Amended Claims

1. (currently amended) A method of magnetic resonance imaging comprising:

(a) administering a magnetic resonance contrast agent to a subject which contrast agent alters  $T_1$ ,  $T_2$  and  $T_2^*$  magnetic resonance characteristics;

(b) exciting magnetic resonance in a region of interest of the subject which receives the contrast agent;

(c) applying a first echo planar readout waveform during the excited resonance and generating a plurality of data lines of first image data;

(d) applying a second echo planar readout waveform during the excited resonance after the first echo planar readout waveform and generating a plurality of lines of  $T_2$  or  $T_2^*$  weighted image data;

(e) reconstructing the image data to generate a first image representation and a  $T_2$  or  $T_2^*$  weighted image representation; and

→ (f) correcting the  $T_2$  or  $T_2^*$  weighted image representation with the first image representation.

2. (original) The method as set forth in claim 1, further including:

applying an RF inversion pulse between the first and second echo planar readout waveforms.

3. (original) The method as set forth in claim 1, further including:

applying a third echo planar readout waveform and generating the other of  $T_2$  and  $T_2^*$  weighted image data.

4. (original) The method as set forth in claim 3, further including:

applying an RF inversion pulse between the second and third echo planar readout waveforms, such that the second echo planar readout waveform generates  $T_2^*$  weighted data and the third echo planar readout waveform generates  $T_2$  weighted data.

5. (original) The method as set forth in claim 4, further including:

reconstructing the  $T_2$  weighted data into a  $T_2$  weighted image representation; and modifying the  $T_2$  weighted image representation with the first image representation.

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6. (currently amended) A The method of magnetic resonance imaging comprising as set forth in claim 1, wherein the reconstructing step includes:

- (a) administering a magnetic resonance contrast agent to a subject which contrast agent alters  $T_1$ ,  $T_2$  and  $T_2^*$  magnetic resonance characteristics;
- (b) exciting magnetic resonance in a region of interest of the subject which receives the contrast agent;

- (c) applying a first echo planar readout waveform and generating first image data;
- (d) applying a second echo planar readout waveform and generating  $T_2$  or  $T_2^*$  weighted image data;
- (e) reconstructing the  $T_2$  or  $T_2^*$  weighted image data and a portion of the first image data to generate the a  $T_2$  or  $T_2^*$  weighted image representation; and
- (f) reconstructing a portion of the  $T_2$  or  $T_2^*$  weighted image data and the first image data to generate the a first image representation; and
- (g) correcting the  $T_2$  or  $T_2^*$  weighted image representation with the first image representation.

7. (original) The method as set forth in claim 6, wherein the portion of the  $T_2$  or  $T_2^*$  weighted readout waveform used to generate the first image representation and the portion of the first image data used to generate the  $T_2$  or  $T_2^*$  weighted image representation include interleaved data lines adjacent an edge of k-space.

8. (original) The method as set forth in claim 7, further including:

generating additional data lines by conjugate symmetry.

9. (original) The method as set forth in claim 1, further including:

repeating steps (b)-(f) a plurality of times to generate a series of first image

representations and a series of  $T_2$  or  $T_2^*$  weighted image representations; and combining the series of first image representations and the series of  $T_2$  or  $T_2^*$  weighted image representations to generate a third series depicting a temporal evolution of the contrast agent in the region of interest.

10. (original) The method as set forth in claim 1, further including:

(g) combining the first image representation and the  $T_2$  or  $T_2^*$  weighted image representation to generate a third image representation; and repeating steps (b) - (g) a plurality of times to generate a series of third image representations depicting a temporal evolution of the contrast agent in the region of interest.

11. (original) The method as set forth in claim 1, wherein the contrast agent includes a gadolinium chelate.

12. (currently amended) The A method as set forth in claim 1, of magnetic resonance imaging comprising:

- (a) administering a magnetic resonance contrast agent to a subject which contrast agent alters at least one of  $T_1$ ,  $T_2$  and  $T_2^*$  magnetic resonance characteristics;
- (b) exciting magnetic resonance in a region of interest of the subject which receives the contrast agent;

- (c) applying a first echo planar readout waveform and generating first image data;
- (d) applying a second echo planar readout waveform and generating  $T_2$  or  $T_2^*$  weighted second image data, wherein at least one of the steps of generating the first image data and generating the second image data includes generating image data using a partial parallel imaging technique;
- (e) reconstructing the image data to generate a first image representation and a  $T_2$  or  $T_2^*$  weighted image representation; and
- (f) correcting the  $T_2$  or  $T_2^*$  weighted image representation with the first image representation.

13. (original) A method of contrast enhanced magnetic resonance imaging in which a subject is injected with a contrast agent, magnetic resonance is excited in a region of interest, the excited magnetic resonance is permitted to decay for a preselected duration to optimize one of  $T_2$  and  $T_2^*$  weighting, and after the preselected duration an echo planar sequence is applied to generate  $T_2$  or  $T_2^*$  weighted data, the method further including:

during the preselected duration, applying another echo planar sequence to generate  $T_1$  weighted data.

14. (canceled)

15. (currently amended) ~~The imaging~~ A method for imaging a patient using a magnetic resonance (MR) imaging

apparatus, said MR apparatus including a patient support means, a main magnet, a slice-select gradient pulse generator, a phase-encode gradient pulse generator, a read gradient pulse generator, a plurality of RF coils, an RF transmitter, and a receiver, the method according to claim 14, further comprising:

administering a contrast agent to the patient;  
exciting a magnetic resonance in the patient using  
the RF transmitter and a first selected least  
one of the plurality of RF coils in conjunction  
with the slice-select gradient generator;  
encoding and reading the magnetic resonance using  
the phase encode and the read gradient  
generators in conjunction with a second  
selected at least one of the plurality of RF  
coils and the receiver, the encoding and  
reading implementing a first echo-planar  
readout waveform;  
encoding and reading the magnetic resonance using  
the phase encode and the read gradient  
generators in conjunction with a third selected  
at least one of the plurality of RF coils and  
the receiver, the encoding and reading  
implementing a second echo-planar readout  
waveform;  
reconstructing the encoded and read magnetic  
resonance into first and second image  
representations; and  
comparing the first image representation with the  
second image representation to obtain a third  
image representation thereby.

16. (original) The imaging method according to claim 15, further comprising:

repeating the steps of exciting a magnetic resonance, encoding, reading, and reconstructing first and second images, and comparing the first images with the second images to obtain third images thereby; and determining a temporal evolution of at least one of the first image, the second image, and the third image.

17. (currently amended) The imaging method according to ~~claim 14~~ claim 15, wherein:

in the step of reconstructing the second image, a portion of the encoded and read resonance from the first echo planar readout waveform is reconstructed into the second image.

18. (currently amended) The imaging method according to ~~claim 14~~ claim 15, wherein:

the first echo planar readout waveform phase encoding includes,

phase encoding a first portion of the resonance such that a  $k_y$  component single-steps in a first direction, and

phase encoding a second portion of the resonance such that the  $k_y$  component double-steps in the first direction;

the second echo planar readout waveform phase encoding includes,

phase encoding a first portion of the resonance such that the  $k_y$  component double-steps opposite to the first direction, and phase encoding a second portion of the resonance such that the  $k_y$  component single-steps opposite to the first direction; and the reconstructing step includes, reconstructing the first and second portions of the first echo planar readout waveform and the first portion of the second echo planar readout waveform into the first image representation, and reconstructing the second portion of the first echo planar readout waveform and the first and second portions of the second echo planar readout waveform into the second image representation.

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19. (original) A magnetic resonance imaging apparatus comprising:

a main magnet which generates a temporally constant magnetic field through an examination region; an RF system which excites and manipulates magnetic resonance in the examination region and which receives and demodulates magnetic resonance signals from the examination region into data lines;

a sorter which sorts the data lines between a first data memory and a second data memory;

a gradient magnetic field system which generates magnetic field gradients across the examination region to spatially encode the resonance signals;

a sequence controller which,

- (i) controls the RF system to induce resonance;
- (ii) controls the RF and gradient systems to implement a first echo planar readout waveform which generates  $T_1$  weighted data lines;
- (iii) controls the RF and gradient systems to implement a second echo planar readout waveform which generates one of  $T_2$  and  $T_2^*$  weighted data lines, and
- (iv) controls the sorter to sort the  $T_1$  and  $T_2$  or  $T_2^*$  weighted data lines between the first and second data memories; and

a reconstruction processor which reconstructs data lines from the first data memory into a first image representation and data lines from the second data memory into a second image representation.

20. (currently amended) The A magnetic resonance apparatus as set forth in claim 19 further including comprising:

a main magnet which generates a temporally constant magnetic field through an examination region;  
an RF system which excites and manipulates magnetic resonance in a region of a subject in the examination region who has been injected with a contrast agent and which receives and demodulates magnetic resonance signals from the examination region into data lines;  
a sorter which sorts the data lines between a first data memory and a second data memory;  
a gradient magnetic field system which generates magnetic field gradients across the examination region to spatially encode the resonance signals;  
a sequence controller which:

(i) controls the RF system to induce resonance,

(ii) controls the RF and gradient systems to implement a first echo planar readout waveform which generates  $T_1$  weighted data lines,

(iii) controls the RF and gradient systems to implement a second echo planar readout waveform which generates one of  $T_2$  and  $T_2^*$  weighted data lines, and

(iv) controls the sorter to sort the  $T_1$  and  $T_2$  or  $T_2^*$  weighted data lines between the first and second data memories; and

a reconstruction processor which reconstructs data lines from the first data memory into a first image representation and data lines from the second data memory into a second image representation;  
~~a means for injecting a contrast agent into a subject in the examination region; and~~  
an image processor for combining the first and second image representations into a contrast agent enhanced image representation.

21. (original) The magnetic resonance apparatus as set forth in claim 20 wherein:

the sequence controller controls the sorter to sort

- (i) all of the  $T_1$  weighted data lines and a portion of the  $T_2$  or  $T_2^*$  weighted data lines into the first image memory and
- (ii) all of the  $T_2$  or  $T_2^*$  weighted data lines and a portion of the  $T_1$  weighted data lines into the second image memory.

22. (original) The magnetic resonance apparatus as set forth in claim 19 wherein the RF system further includes:

a phased array receive coil; and  
a partial parallel imaging (PPI) integrator which processes the readout of the phased array receive coil to generate data lines.

23. (original) The magnetic resonance apparatus as set forth in claim 22 wherein the partial parallel imaging (PPI) integrator processes the readout of the phased array receive coil using one of a simultaneous acquisition of spatial harmonics (SMASH) technique, a sensitivity encoding (SENSE) technique, and a parallel imaging with localized sensitivities (PILS) technique.



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